METHOD AND APPARATUS FOR SUPPORTING A RAISED FLOOR AND A TOOL

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Field of the Invention

The present invention is related to industrial architecture and more specifically to support systems for tools and flooring in industrial cleanrooms.

Background of the Invention

Conventional industrial cleanrooms are used to house tools for semiconductor processing, pharmaceutical manufacturing, biotechnology product manufacturing, food processing and for other industrial uses. Within the cleanroom, a modular floor raised above a subfloor is used to easily allow services including electrical service and gases or liquids to be brought to tools used for the processing operation of the cleanroom or a related operation such as cleaning portions of other tools. Raised

modular floors also provide ease of reconfiguration of the cleanroom.

Conventional raised modular floors have a limit on the weight they can support. The limit is the lesser of the limit of the material used for the flooring itself and the support members used to raise the modular floor, although both limits may be nearly the same or identical. If a tool to be placed on the raised floor exceeds the lower of these weight limits, the tool can break through the floor, or may simply bend the supports or flooring tiles, or may compress the flooring tiles, which are corrugated like cardboard and therefore subject to compression.

To avoid this problem, such a tool is not placed on the floor. Although the tool could be placed on the floor and the supports for that section of the floor could be increased, the fact that the tool could compress the corrugated floor would make it difficult to level the tool to the tolerances some tools require. Instead, the floor tiles are removed and some are possibly cut to leave a hole in the floor slightly smaller than the footprint of the tool. The tool is then supported by means of tripods or other supports that come into direct contact with the subfloor of the cleanroom. Because the raised floor around

the cutout must be supported, a frame is built between the raised floor and the subfloor, just outside the perimeter of the hole in the raised floor. Additional floor supports may be used to provide additional support for the raised subfloor near the hole.

However, there are several problems with this approach. The frame and additional supports are costly to install. Furthermore, they impede access to the area under the tool, impeding the running of services to the tool or making them more difficult to install. The frame could be replaced by a separate set of supports for the raised floor, but these new supports combined with the supports required for the tool could together impede running of services to the tool.

Some tools are supplied with a ledger plate that can be bolted to the supports for these heavy tools and support the floor around the hole, eliminating the need for flooring or other supports. The ledger plate is a piece of angle iron which is a flat piece of metal (it need not be iron) bent in the shape of an 'L'. To ensure that the floor supported in this fashion is highly level, and thereby avoid hazards to operators walking nearby the tool, these ledger plates are custom attached on site, either by

drilling the ledger plate and support to allow precise bolting or by welding the ledger plate onto the support.

Although this arrangement solves the access problem of the frame, there are problems with this approach as well. The processes performed in cleanrooms are extremely sensitive to even the smallest amount of contamination. Thus, expensive containment procedures must be followed to install the ledger plates to the supports using the above procedures. In the event of an error, significant contamination from the drilling or welding processes may be introduced into the cleanroom, potentially contaminating several batches of materials in process and requiring an expensive and time consuming cleanup, during which time a portion of the cleanroom must be removed from service, adding additional expense to the process.

What is needed is a method and system for supporting a raised floor near a tool without requiring a frame and without drilling or welding the tool support.

Summary of Invention

A system and method supports at least a portion of a raised floor and at least a portion of a tool by adjusting a portion supporting the floor, and this portion may then

be locked into place. A product may be produced using the tool.

Brief Description of the Drawings

Figure **1A** is a block diagram of a support according to one embodiment of the present invention.

Figure **1B** is a block diagram of a base of the support of Figure **1A** according to one embodiment of the present invention.

Figure **1C** is a block diagram of a base of the support of Figure **1A** according to another embodiment of the present invention.

Figure **2A** is a block diagram of a tool about to be lowered onto a group of supports that will support the tool and the edge of a raised floor around a hole approximately the size and shape of the tool according to one embodiment of the present invention.

Figure **2B** is a flowchart illustrating a support supporting a raised floor having a hole closer to the same size as the cross section of the support at the level of the raised floor than the size of the footprint of the tool, and capable of supporting the tool according to one embodiment of the present invention.

Figure 3 is a flowchart illustrating a method of supporting a raised floor and a tool according to one embodiment of the present invention.

Detailed Description of a Preferred Embodiment

Referring now to Figure 1A, a support **100** for supporting a tool and a raised floor is shown according to one embodiment of the present invention. Support **100** includes three components: a first component **114** for supporting the tool, a second component **120** for supporting a raised floor and a third component **110** that is coupled to the first component **114** and second component **120** and whereby at least one of the second component **120** and third component **110** include an adjustable attachment structure allowing at least an initial position adjustment of the second component relative to the first component. These components will now be described with reference to representative embodiments.

The third component, support member **110** is a conventional support member such as a channel made from steel, iron, plastic or any other material capable of supporting the expected load provided to support member **110** from the portion of the tool and the floor support member **110** will be supporting. Support member **110** may have a

square cross section in one embodiment such as is shown in the Figure, although any other cross section such as an "I", "T", "O", triangle or flat cross section may be used.

In one embodiment, support member **110** is supported by a base **116**. Support member **110** may be attached to base using any means such as molding it to the base **116**, welding it to the base **116**, bolting it to the base **116** or any other means. In another embodiment, base **116** is not used and support member **110** is placed directly on the subfloor and bolted or otherwise attached to the subfloor. If the base is used, the cannel **110** and the base **116** need not be attached to one another, as base **116** may have a slot for insertion of support member **110**. Base **116** may be of any shape, such as the tripod shown in Figure **1B** or a flat or box shaped base such as the box shaped base shown in Figure **1C**.

In one embodiment, the height of base **116** is adjustable in one or more location at the bottom or other location of base **116**, such as four height adjusters **118** of Figure **1C** (only two of which are visible in the Figure). If the height is adjustable in more than one location, the height adjusters **118** may be used to level the support member in the vertical position to accommodate a non level

subfloor. One or more height adjusters **118** may also be used to adjust the overall height of the top **114** of support member **110** to allow a plurality of supports **100** to accommodate variances in shape of both the floor and the tool the support **100** will be used to support. Base **116** may be adjustable at other locations other than the bottom. For example, if base **116** is a tripod, the angle and length of each leg may be independently adjustable, for example, using hinges or lockable telescoping legs or both.

The first component described above, the top **114** of support member **110**, may support the tool by resting the tool on it in one embodiment, or in another embodiment, the tool may be bolted or otherwise attached to an area of support member **110** at or near the top **114** using any attachment structure such as those described herein. Holes may be drilled into support member **110** at or near the top **114** to accommodate such an attachment means.

Support member **110** contains one or more holes **112** (which may be threaded to allow attachment via a bolt or screw or the bolt or screw may be inserted entirely through support member and a nut used on the other side of support member to tighten the bolt) or other attachment structure that may be used in attachment such as notches or the like

to allow the attachment of a ledger plate **120**, the second component described above. Ledger plate **120** includes hole **126** or other structure that may be used in attachment with the structure **112**. The structures **112** and **126** may allow not only attachment, but can provide adjustability in one embodiment such as by the use of a hole larger than a bolt or screw used for attachment, so that horizontal portion **124** of the ledger plate **120** may be used to support at least an edge of a raised floor at whatever height the raised floor may be.

The two attachment structures **112** and **126** may be used together with a bolt, screw or other structure to complete the attachment capability as described above. This allows adjustment on site without drilling or welding, but then allows the position of ledger plate relative to top **114** to be locked in place. In one embodiment, more than one hole **112** on at least one side of support member **110** are located at heights approximately corresponding to standard heights of a raised floor in a cleanroom, and the heights may take into account the expected height of the base **116**, if any. The structures **112**, **126** and any other structure used in the attachment may be made to allow adjustment of not only the height but also, optionally, the angle, of the horizontal portion **124**. Two holes side by side may replace each of

holes **112** and **126** to allow adjustment in multiple dimensions with additional set strength, although a single hole also provides such adjustment.

In one embodiment, the width of horizontal portion **124** of ledger plate **120** may be significantly wider than support member **110** to allow horizontal portion to support more than one section of a raised floor. Ledger plate **120** is shown in the Figure as having the horizontal portion **124** at the bottom, however, the ledger plate **120** may be inverted to allow horizontal portion **124** to be at the top of the ledger plate.

It isn't necessary that the ledger plate **120** have an "L" shape, as any shape of ledger plate may be used as long as it can attach to support member **110** and support a part of a raised floor. It isn't even necessary that horizontal portion **124** extend past the edge of the remainder **112** of the ledger plate **120** as the ledger plate may be made out of a block, with the top of the block being the horizontal portion **124** used to support the at least the edge of the raised floor and the side of the block attached to support member **110**.

Referring now to Figures **1A** and **2A**, a plurality of the supports **100** of the present invention are shown placed on a

subfloor **142** for supporting a tool **130** above or in a hole **140** in a raised floor. In one embodiment, the hole **140** is approximately the size and shape of the footprint of the tool. Each support **100** may have one or more ledger plates **120** attached to the support member **110**. For example, the supports **100** in each corner of the hole may have two ledger plates **120** attached to the support member with the other supports **100** having one ledger plate **120** attached to the support member.

In another embodiment illustrated in Figure **2B**, a small hole **150**, closer to the size of the cross section of support member **110** is cut in a section of the raised floor at the location of each support member **110** of the supports **100** placed on a subfloor **154**. In such embodiment multiple ledger plates **120** may be attached to a single support member **110** to support the raised floor **152** around the ledger plate. Multiple of the supports **100** may be used to support a single tool as described above with reference to Figure **2A**, however, an individual hole **150** may be precut in the section **152** of the floor surrounding support member **110** of each support **100**. The tool would be supported at or near the top **114** of the support **100** as described above, above the subfloor. Some of the other floor tiles under

the tool may still be removed to create a hole to provide services to the tool.

According to the present invention, most or all of the weight of the tool **130** is supported by any number of supports **100** and substantially more of the portion of the tool each support **100** is supporting is supported by the support **100** than the area of the raised floor near the support **100**. In other words, the tool may be supported by support above the raised floor, or may be touching the raised floor with much less of the weight of the tool **130** being supported by the raised floor than the number of supports **100** supporting the tool **130**. This prevents the raised floor from compressing or otherwise being damaged by the weight of the tool. If the tool is above the raised floor, a skirt may be placed under the tool.

In other embodiments, the base of the tool may also sit lower than the raised floor. In such embodiment, the tool may be supported by a portion of the support member **110** that is below the top **114** of the support member, such as via another ledger plate. In one embodiment, the tool is a conventional tool for producing semiconductor, pharmaceutical, biotechnology or food products.

Referring now to Figure **3**, a method of supporting a tool and a portion of a raised floor is shown according to one embodiment of the present invention. A support is supported **310** by a subfloor, for example on a base supported by the subfloor as described above. A position of a horizontal portion attached to the support is adjusted **312** corresponding to the height of the raised floor as described above using a structure attached to the support that allows adjustment as described above. Step **312** may include locking the horizontal portion, such as by tightening a screw or bolt in place as described above. In one embodiment, step **312** is performed in a clean room without drilling or welding as described above. At least a portion of the raised floor is supported **314** with the horizontal portion adjusted in step **312** as described above. A processing tool is also supported by the support **316**, and may sit on or be supported somewhat by the raised floor. Most or all of the weight of the tool is supported by the support and not the raised floor as described above. A product is manufactured **318** using the tool supported in step **316**. The product may be a semiconductor, pharmaceutical, biotechnology product or food product. The raised floor may operate as a floor of a cleanroom in one embodiment of the present invention.